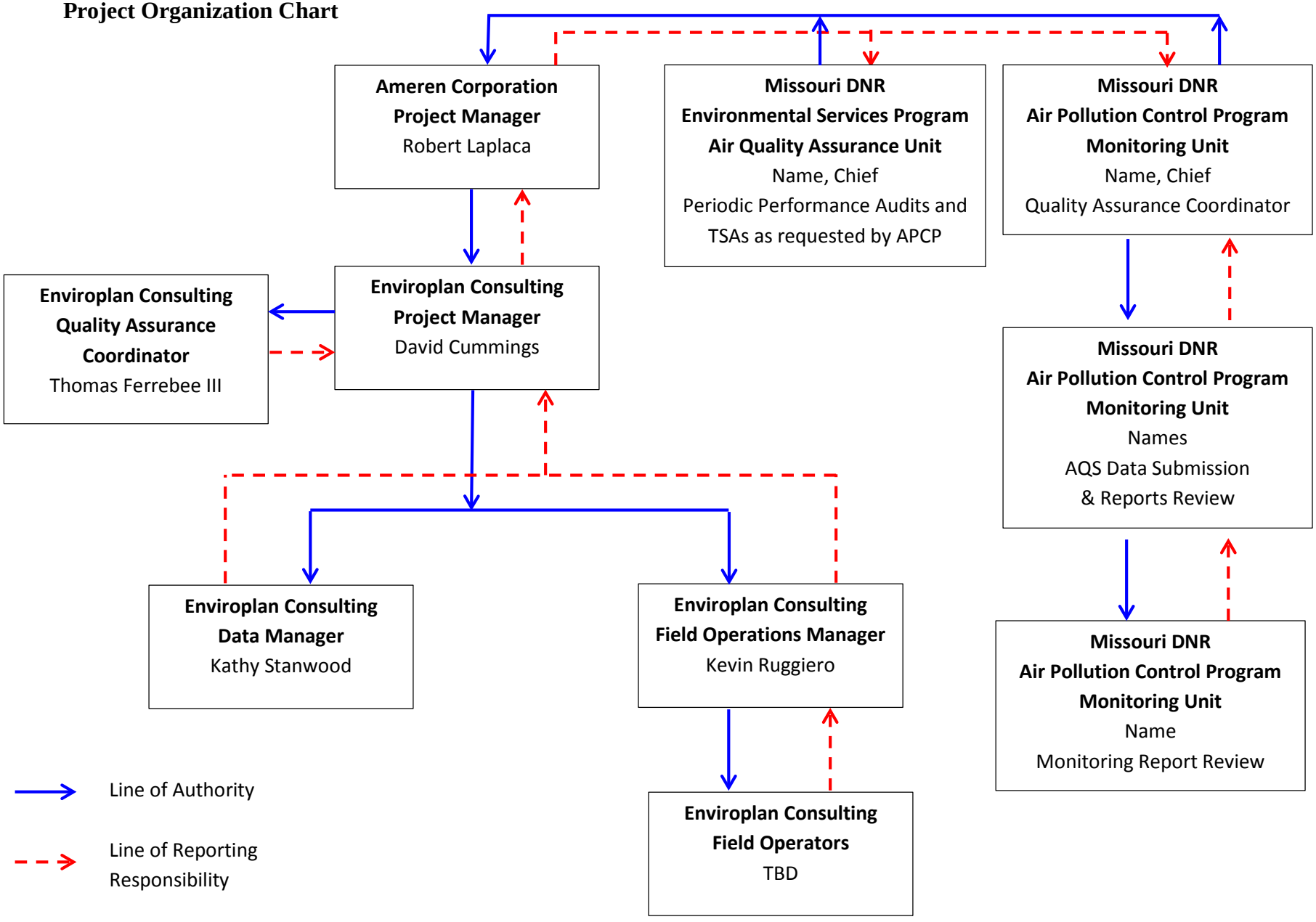
APPENDIX 1

Organizational Chart

Project Organization Chart



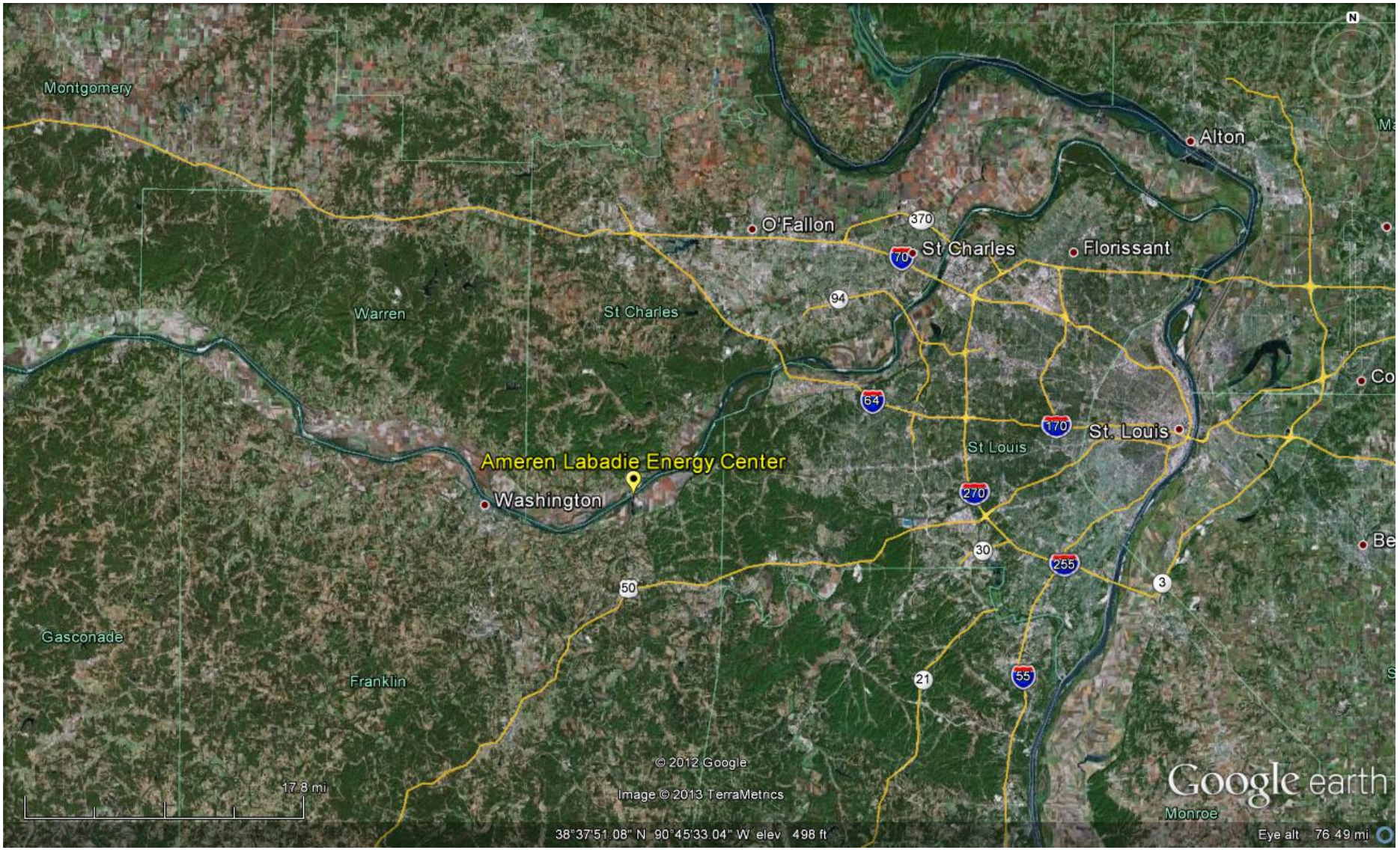
Appendix 2

Ambient Air Monitoring Network Site Information

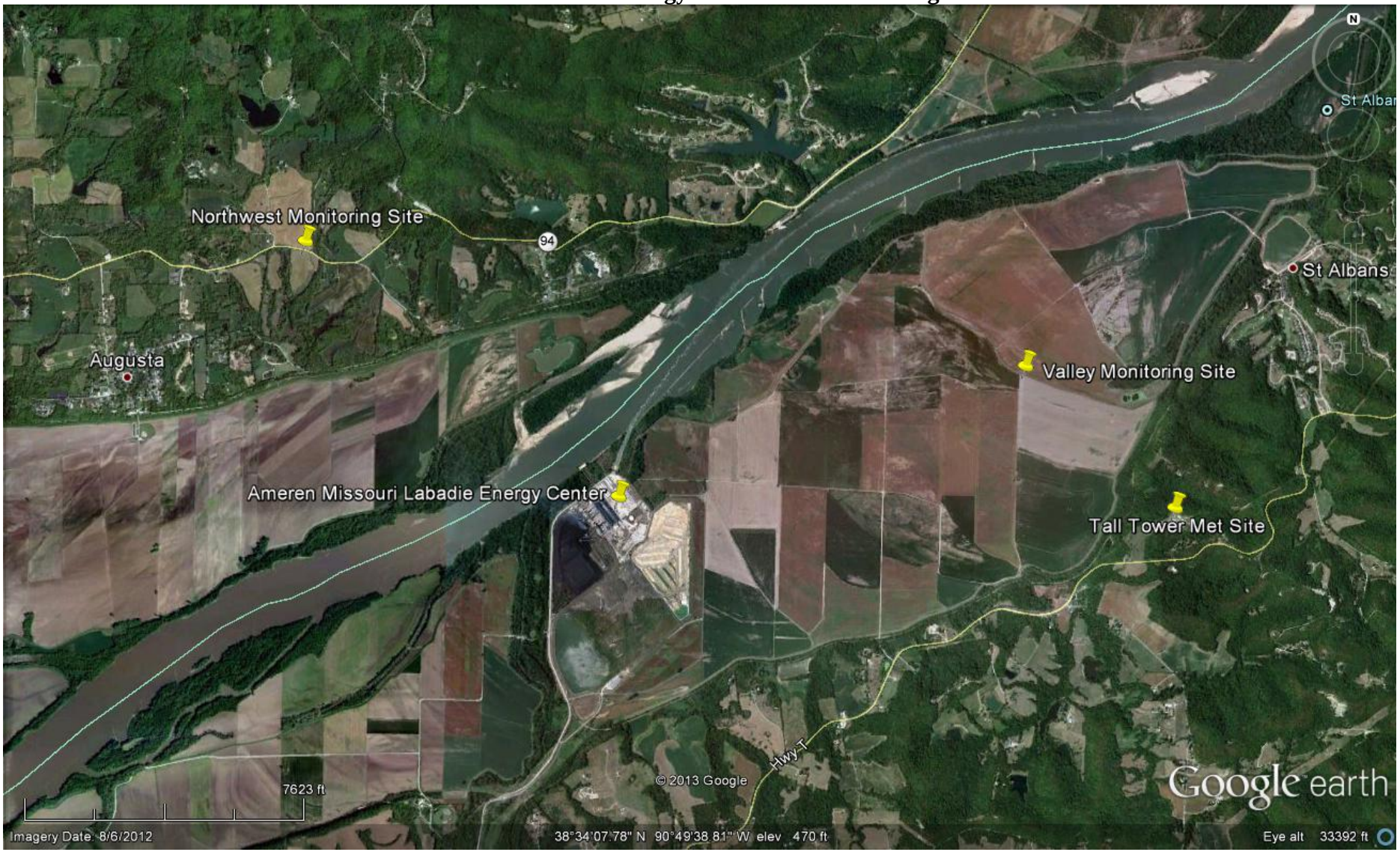
- **Monitoring Sites Location and Geographical Coordinates**
- **Ameren Labadie Energy Center and Geographic Environs**
- **Aerial View of Ameren Labadie Energy Center with Monitoring Site Locations**
- **Topographic View of Area within 4 Km of Labadie Energy Center**
- **Topographic View of Area Surrounding the Northwest Monitoring Site**
- **Topographic View of Area Surrounding the Valley Monitoring Site**
- **Topographic View of Area Surrounding the Tall Tower Monitoring Site**
- **Overhead View of Northwest Monitoring Site**
- **Photographic Views Looking Towards the Northwest Site**
- **Photographic Views Looking Away From the Northwest Site**
- **Overhead View of Valley Monitoring Site**
- **Photographic Views Looking Towards the Valley Site**
- **Photographic Views Looking Away From the Valley Site**
- **Overhead View of Tall Tower Met Monitoring Site**
- **Photographic Views Looking Towards the Tall Tower Met Site**
- **Photographic Views Looking Away From the Tall Tower Met Site**
- **Annual Climate Graph for 2012 for the St. Louis NWS Station**
- **Month of March Wind Rose Plots from 1961 to 2002**
- **Month of June Wind Rose Plots from 1961 to 2002**
- **Month of September Wind Rose Plots from 1961 to 2002**
- **Month of December Wind Rose Plots from 1961 to 2002**

Monitoring Sites Location and Geographical Coordinates			
Site Designation	**Location**	**Geographical Coordinates**	**UTM Coordinates NAD 83 Datum, Zone 15**
Northwest Site	App. 3.2 km northwest of the Labadie Energy Center	Latitude: 38° 34' 54.48" N; Longitude: 90° 51' 55.90" W	4272530.402m Northing; 685920.407m Easting
Valley Site	App. 3.7 km east-northeast of the Labadie Energy Center	Latitude: 38° 34' 21.08" N; Longitude: 90° 47' 48.88" W	4271641.912m Northing; 691922.523m Easting
Tall Tower Site	App. 4.7 km east of the Labadie Energy Center	Latitude: 38° 33' 43.15" N; Longitude: 90° 46' 58.82" W	4270501.750m Northing; 693162.265m Easting

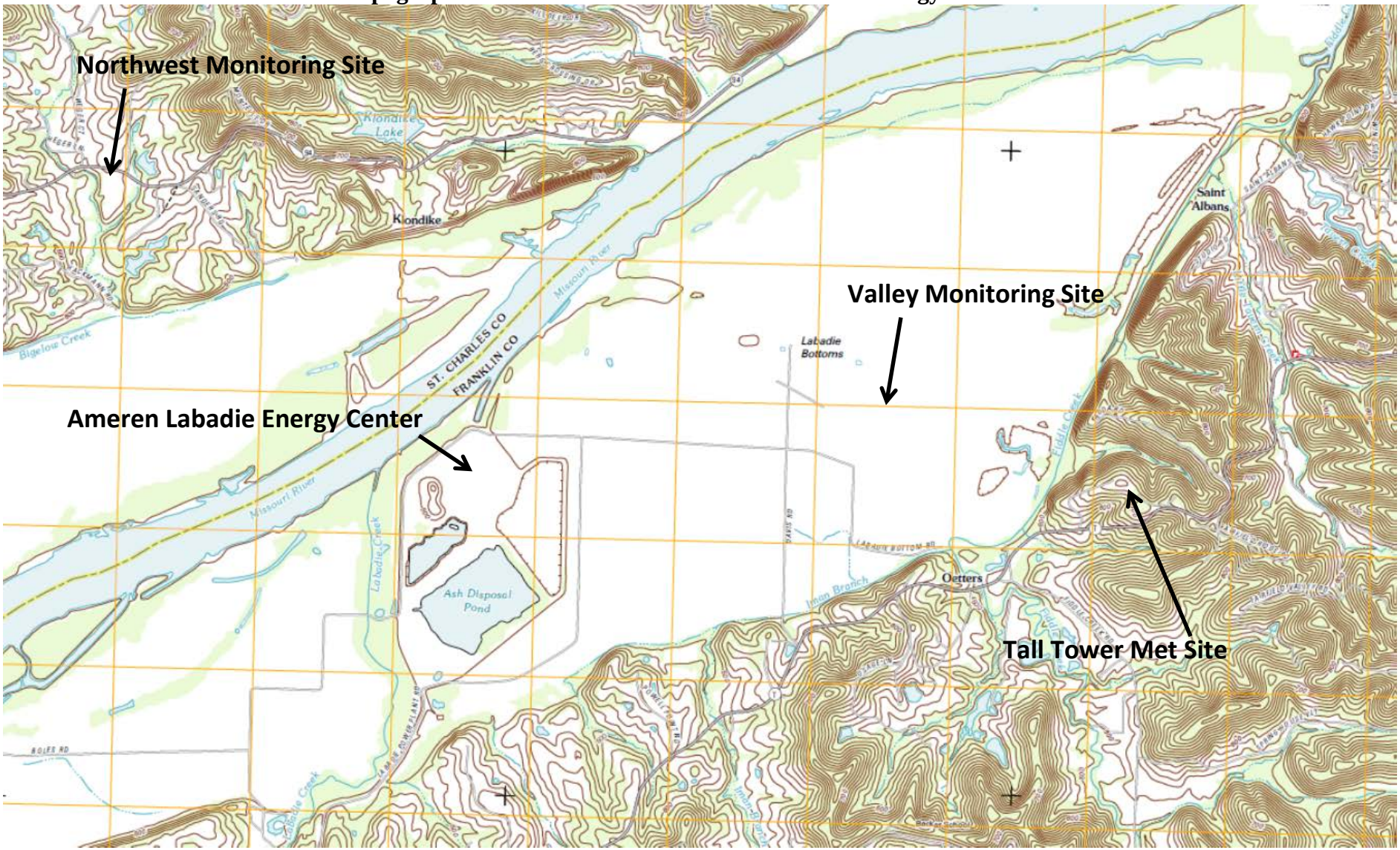
Ameren Labadie Energy Center and Geographic Environs



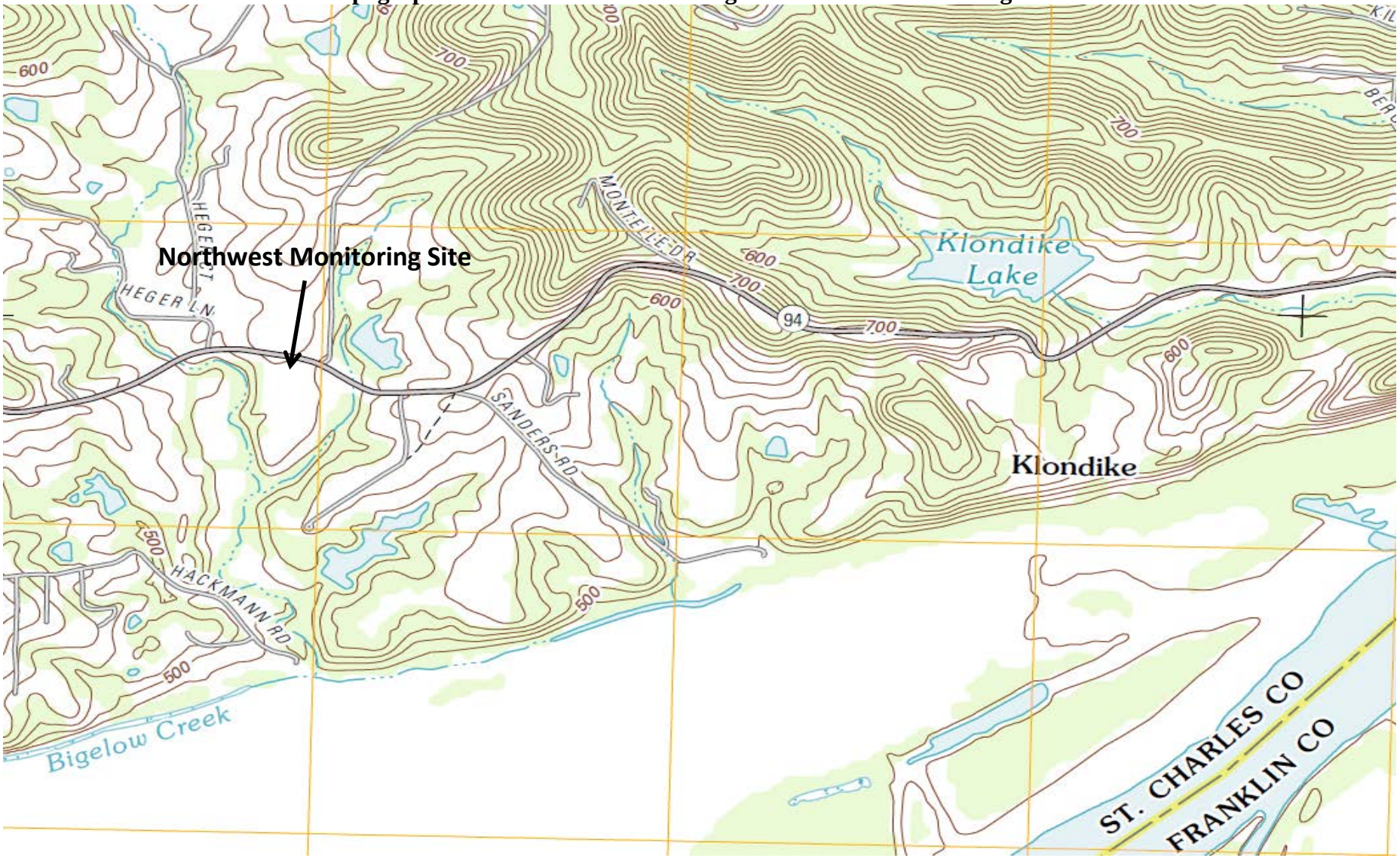
Aerial View of Ameren Labadie Energy Center with Monitoring Site Locations



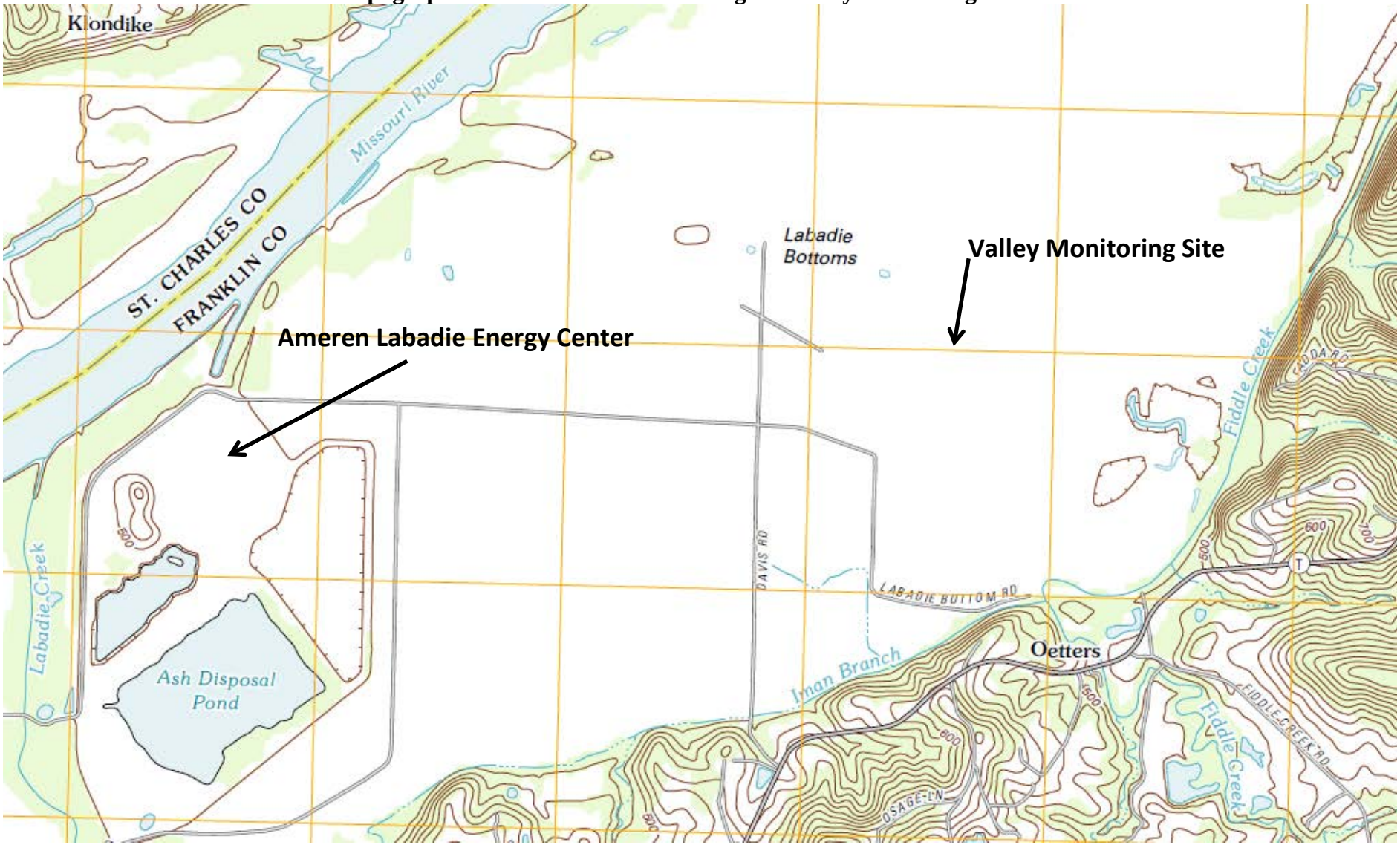
Topographic View of Area within 4 Km of Labadie Energy Center



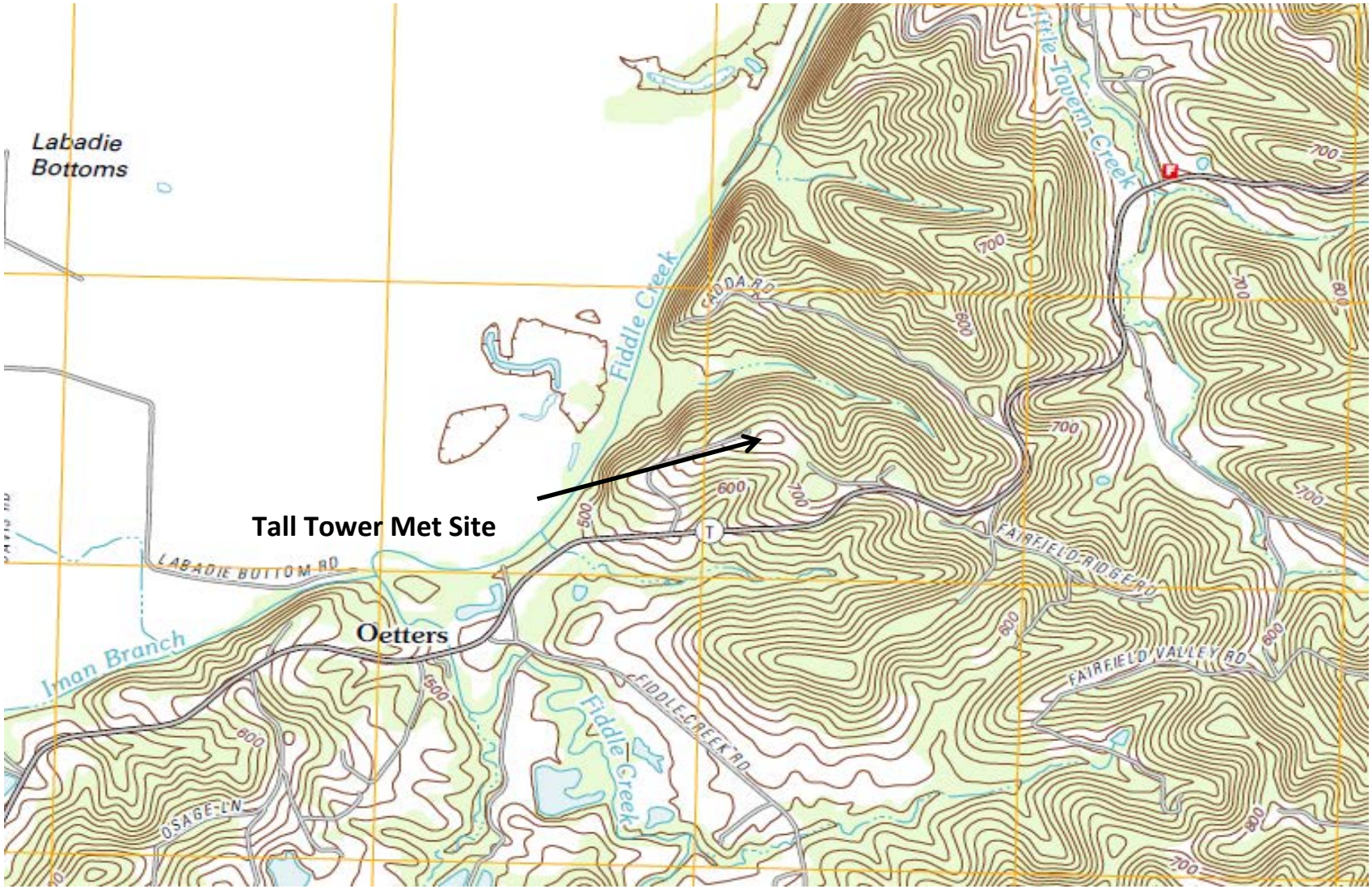
Topographic View of Area Surrounding the Northwest Monitoring Site



Topographic View of Area Surrounding the Valley Monitoring Site



Topographic View of Area Surrounding the Tall Tower Monitoring Site



Overhead View of Northwest Monitoring Site

Photographic Views Looking Towards the Northwest Site

Looking Towards the Site from the North

Looking Towards the Site from the South

Looking Towards the Site from the East

Looking Towards the Site from the West

Photographic Views Looking Away From the Northwest Site

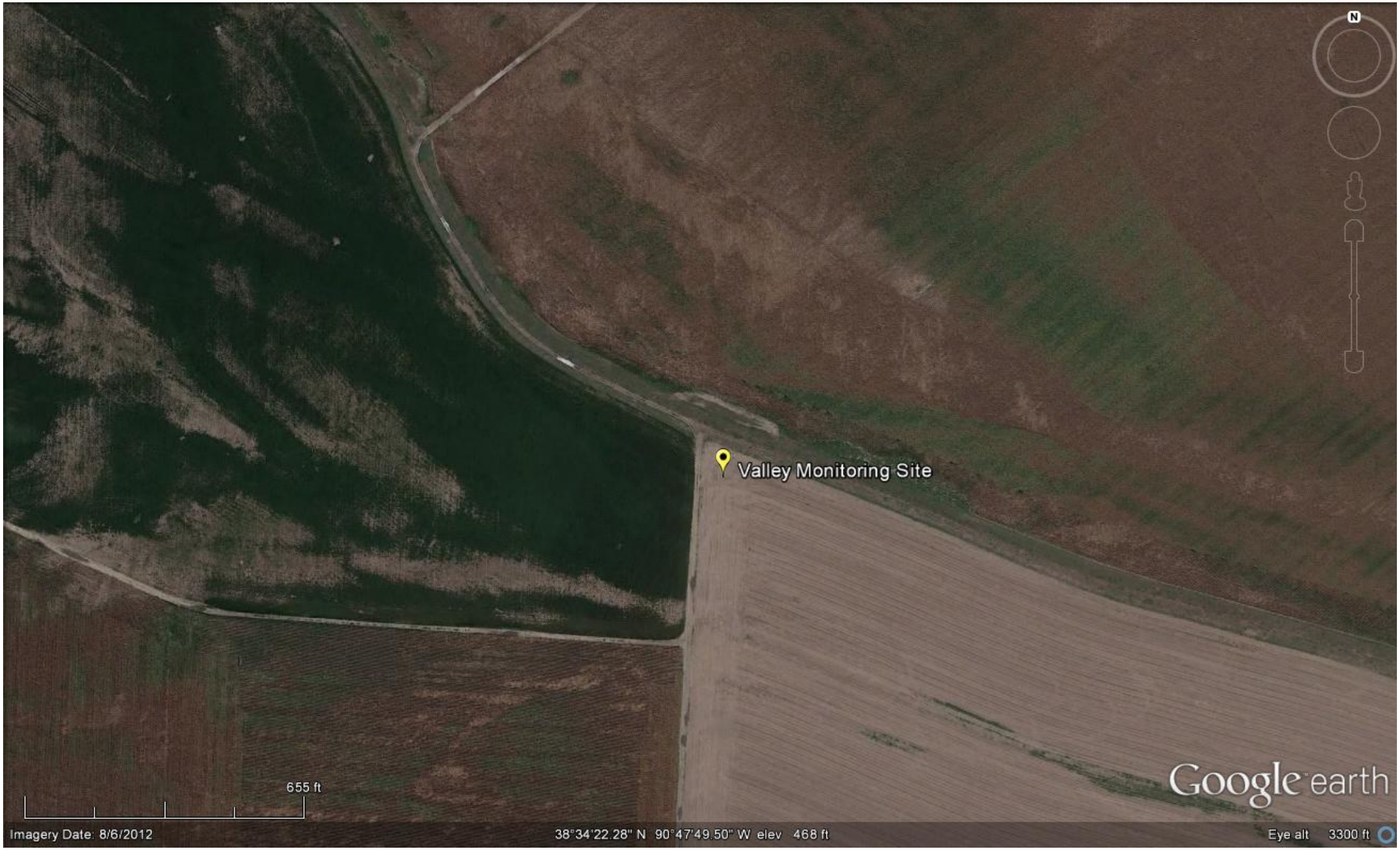
Looking From the Site to the North

Looking From the Site to the South

Looking From the Site to the East

Looking From the Site to the West

Overhead View of Valley Monitoring Site



Photographic Views Looking Towards the Valley Site

Looking Towards the Site from the North

Looking Towards the Site from the South

Looking Towards the Site from the East

Looking Towards the Site from the West

Photographic Views Looking Away From the Valley Site

Looking From the Site to the North

Looking From the Site to the South

Looking From the Site to the East

Looking From the Site to the West

Overhead View of Tall Tower Met Monitoring Site

Photographic Views Looking Towards the Tall Tower Site

Looking Towards the Site from the North

Looking Towards the Site from the South

Looking Towards the Site from the East

Looking Towards the Site from the West

Photographic Views Looking Away From the Tall Tower Site

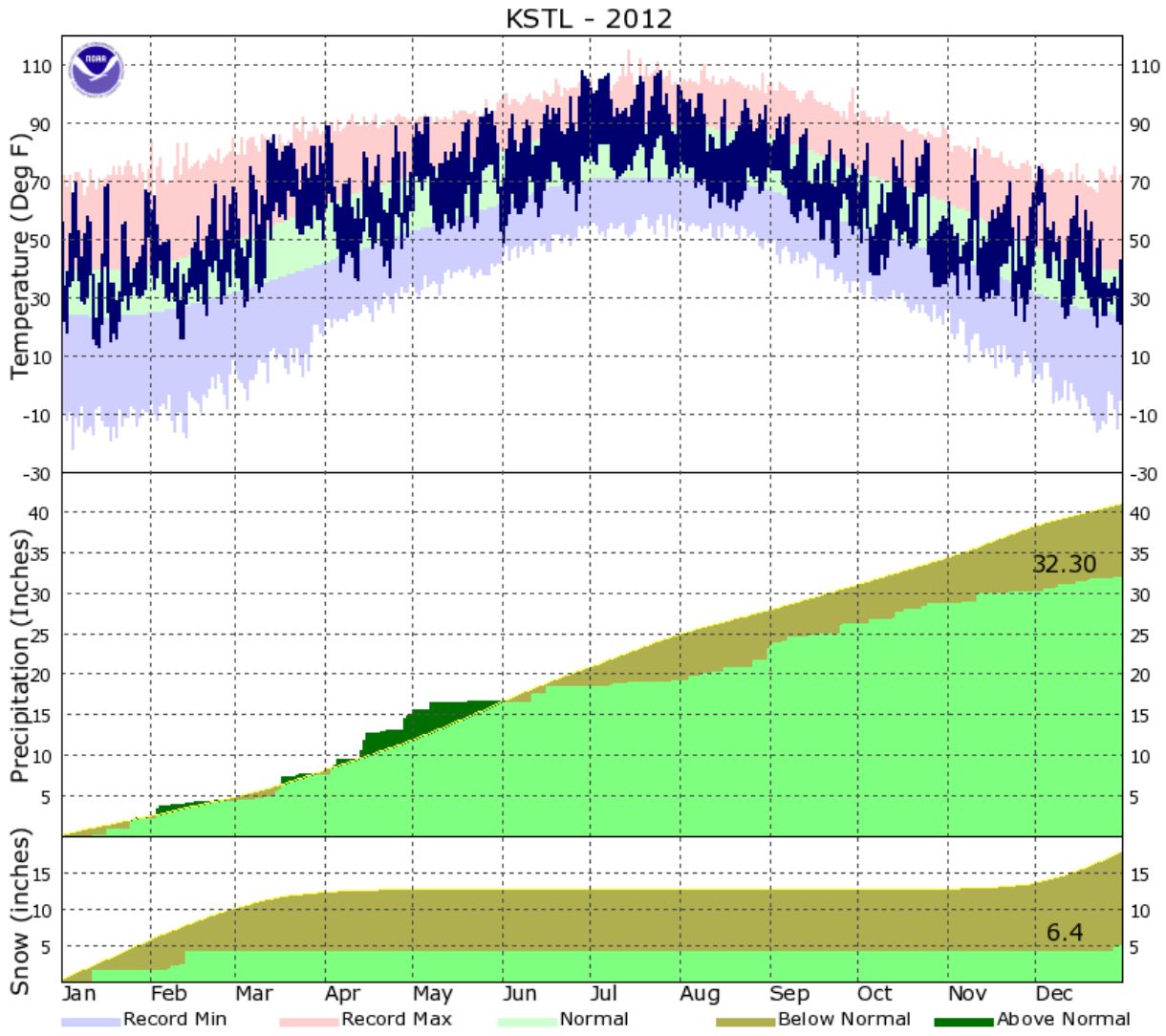
Looking From the Site to the North

Looking From the Site to the South

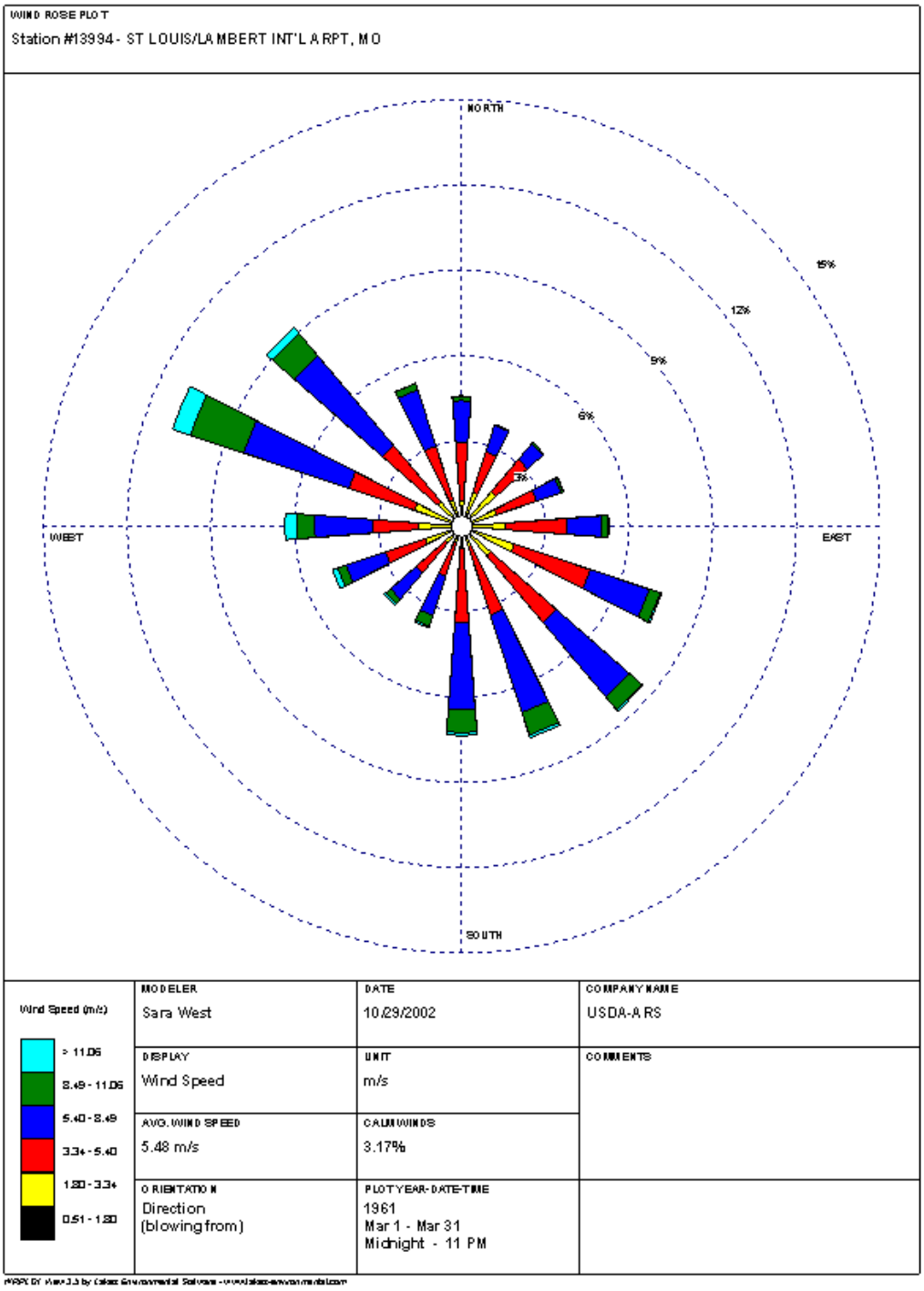
Looking From the Site to the East

Looking From the Site to the West

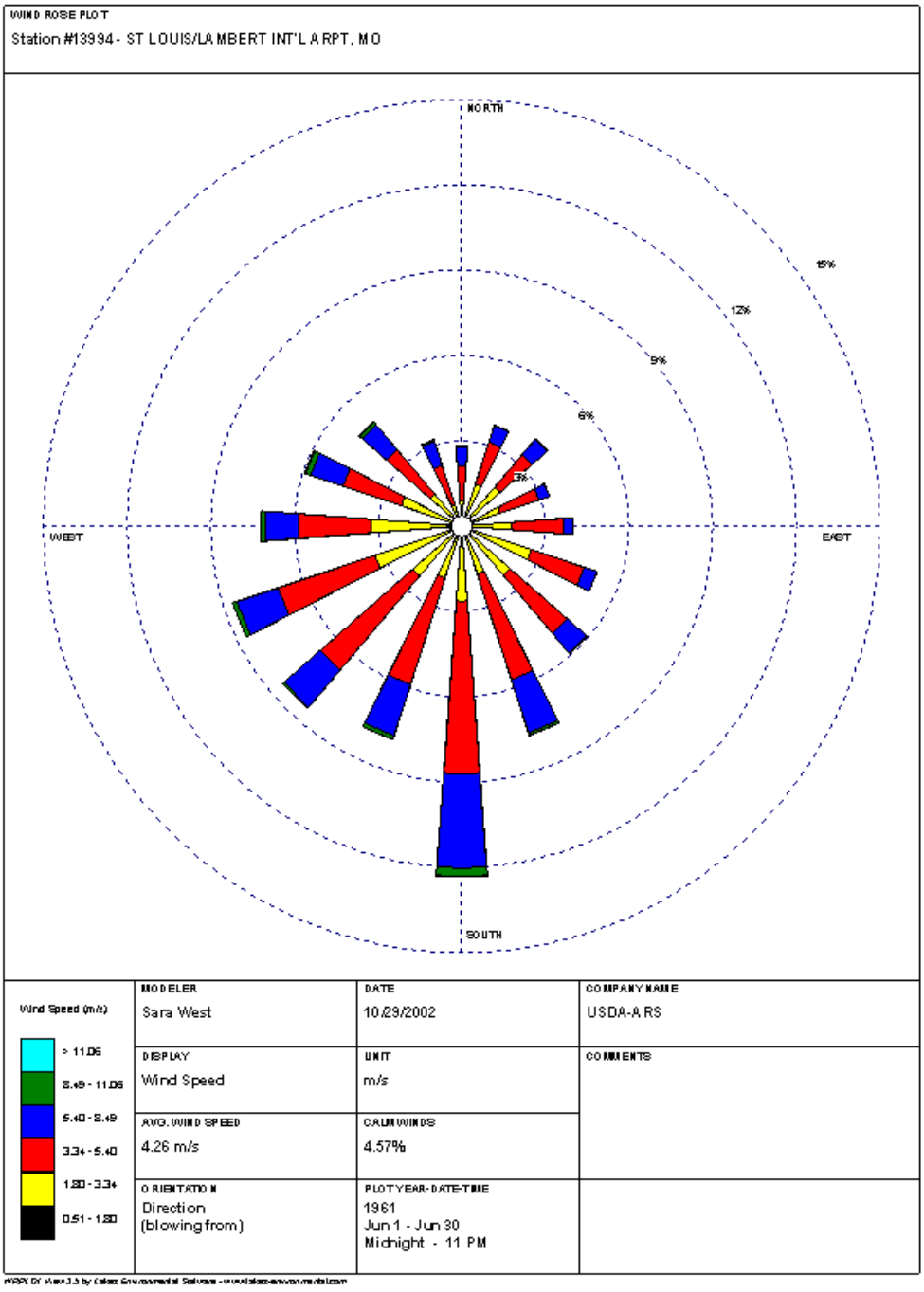
Annual Climate Graph for 2012 for the St. Louis NWS Station



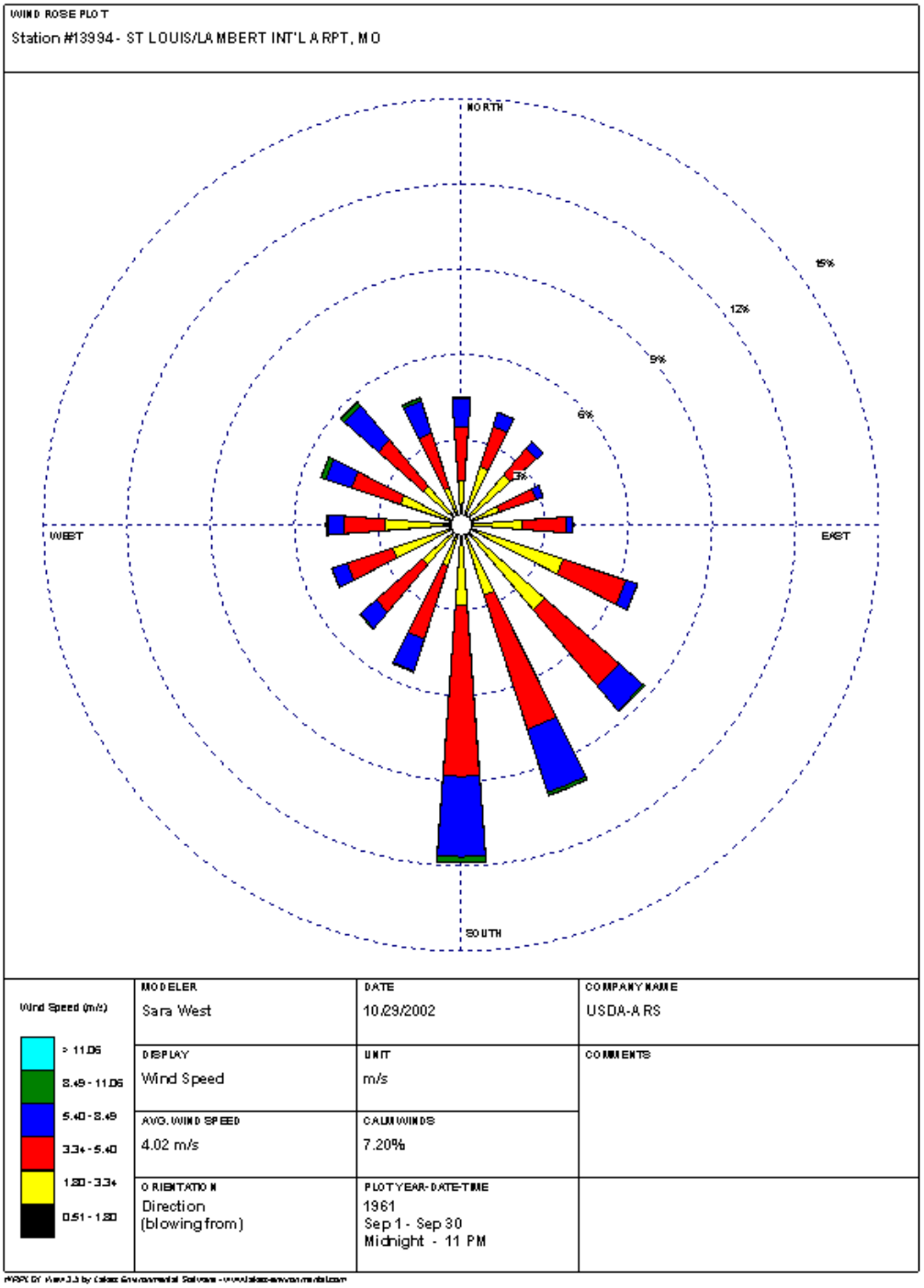
Month of March Wind Rose Plots from 1961 to 2002



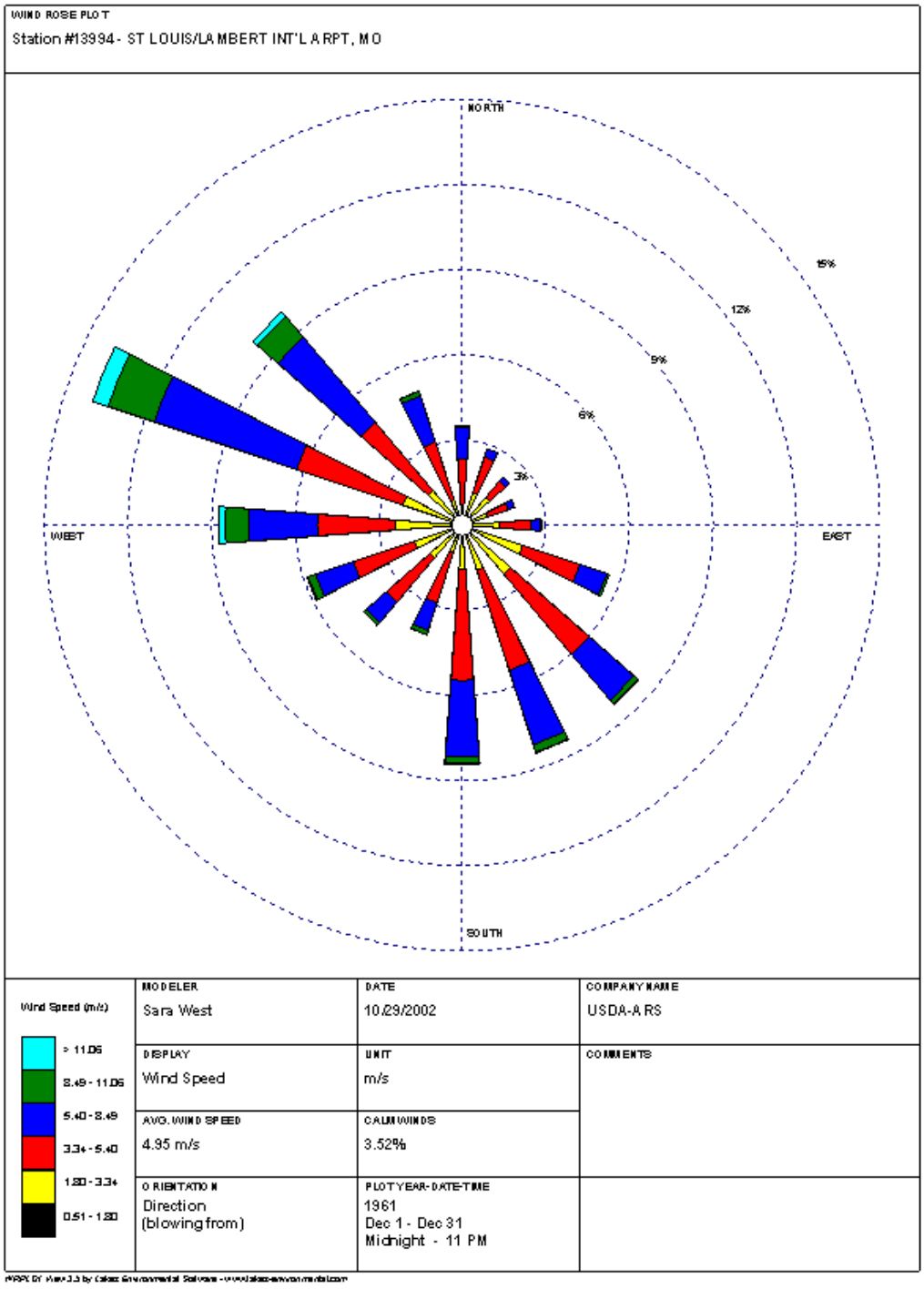
Month of June Wind Rose Plots from 1961 to 2002



Month of September Wind Rose Plots from 1961 to 2002



Month of December Wind Rose Plots from 1961 to 2002



APPENDIX 3

Parameter Tables

- **Monitoring Sites and Parameters for the Labadie Sulfur Reduction Project**
- **Monitored Parameters, AQS Parameter, Method, Duration, and Report Unit Codes**
- **AQS Null Data Codes**

Monitoring Sites and Parameters for the Labadie Sulfur Reduction Project				
Monitored Parameters	**Measurement Frequency, Range and Units**	**Probe Level (meters)**	**Measurement Reporting Resolution**	**Instrument / Method**
Northwest Site				
SO_2	Continuous 0 to 500 ppb	3	1 ppb	Ultraviolet fluorescent
Valley Site				
SO_2	Continuous 0 to 500 ppb	3	1 ppb	Ultraviolet fluorescent.
Horizontal Wind Speed	Continuous 0 to 125.0 mph	10	0.1mph	Cup Anemometer
Horizontal Wind Direction[1]	Continuous 0 to 360°	10	1°	Vane
Sigma Theta (Standard Deviation of Wind Direction)[2]	Continuous 0 to 100°	10	1°	Calculated
Vertical Wind Speed	Continuous ±25 mph	10	0.1mph	Propeller Anemometer
Sigma W (Standard Deviation of Vertical Component of WS)	Continuous 0 to 25 mph	10	0.1mph	Calculated
Ambient Air Temperature	Continuous -22° to +122°F	2	0.1°F	Aspirated RTD
Air Temperature	Continuous -22° to +122°F	10	0.1°F	Aspirated RTD
Temperature Difference	Continuous °F	10-2	0.1°F	Calculated
Relative Humidity	Continuous 0 to 100%	2	1%	Aspirated Thin film polymer capacitor
Solar Radiation	Continuous 0-1,495 W/m^2	1	1 W/m^2	Thermopile-Type Detector
Barometric Pressure	Continuous 900 to 1100 mbar	1.5	1mb	Capacitive Transducer
Precipitation	Continuous 0 to unlimited inches	1.5	0.01 inches	Tipping bucket

Monitoring Sites and Parameters for the Labadie Sulfur Reduction Project				
Monitored Parameters	**Measurement Frequency, Range and Units**	**Probe Level (meters)**	**Measurement Reporting Resolution**	**Instrument / Method**
Tall Tower Site				
Horizontal Wind Speed	Continuous 0 to 125.0 mph	65, 30	0.1mph	Cup Anemometer
Horizontal Wind Direction[1]	Continuous 0 to 360°	65, 30	1°	Vane
Sigma Theta (Standard Deviation of Wind Direction)[2]	Continuous 0 to 104°	65, 30	1°	Calculated
Vertical Wind Speed	Continuous ±25 mph	65, 30	0.1mph	Propeller Anemometer
Sigma W (Standard Deviation of Vertical Component of WS)	Continuous 0 to 25 mph	65, 30	0.1mph	Calculated
Air Temperature	Continuous -22° to +122°F	65, 30	0.1°F	Aspirated RTD
Temperature Difference	Continuous °F	65-30	0.1°F	Calculated

NOTES:

1. Scalar-averaged and resultant-vector values for wind direction will be collected for horizontal wind direction.
2. The standard deviation of the horizontal wind direction will be derived from each of the scalar-averaged and resultant vector wind direction averages. For an hourly average, the standard deviation will be calculated based on four 15-minute values averaged to minimize the effects of wind meander associated with light wind speed conditions.

Monitored Parameters, AQS Parameter, Method, Duration, and Report Unit Codes				
Monitored Parameters	**Parameter Code**	**Method Code**	**Duration Code**	**Reported Unit**
SO_2	42401	100	1	8
SO_2	42401	100	H	8
Horizontal Wind Speed - Scalar	61101	63	1	12
Horizontal Wind Speed - Vector	61103	20	1	12
Vertical Wind Speed	61109	20	1	12
Standard Deviation of Vertical Wind Speed	61110	20	1	12
Horizontal Wind Direction - Scalar	61102	63	1	14
Standard Deviation of Horizontal Wind Direction - Scalar	61106	20	1	14
Horizontal Wind Direction - Vector	61104	20	1	14
Standard Deviation of Horizontal Wind Direction - Vector	61107	20	1	14
Ambient Air Temperature	62101	40	1	15
Temperature Difference	62106	41	1	117
Relative Humidity	62201	61	1	19
Barometric Pressure	64101	15	1	16
Precipitation	65102	11	1	21
Solar Radiation	63301	11	1	79

AQS Null Data Codes	
Qualifier Code	**Item Description**
AB	TECHNICIAN UNAVAILABLE
AC	CONSTRUCTION/REPAIRS IN AREA
AD	SHELTER STORM DAMAGE
AE	SHELTER TEMPERATURE OUTSIDE LIMITS
AI	INSUFFICIENT DATA (CAN'T CALCULATE)
AM	MISCELLANEOUS VOID
AN	MACHINE MALFUNCTION
AO	BAD WEATHER
AP	VANDALISM
AS	POOR QUALITY ASSURANCE RESULTS
AT	CALIBRATION
AU	MONITORING WAIVED
AV	POWER FAILURE (POWR)
AW	WILDLIFE DAMAGE
AX	PRECISION CHECK (PREC)
AY	Q C CONTROL POINTS (ZERO/SPAN)
AZ	Q C AUDIT (AUDT)
BA	MAINTENANCE/ROUTINE REPAIRS
BB	UNABLE TO REACH SITE
BC	MULTI-POINT CALIBRATION
BD	AUTO CALIBRATION
BE	BUILDING/SITE REPAIR
BF	PRECISION/ZERO/SPAN
BJ	Operator Error
BK	Site computer/data logger down

APPENDIX 4

Data Quality Requirements and Assessments

A. Data Quality Requirements and Assessments, Meteorological Measurements
B. Ambient Air Monitoring - Measurement Quality Objectives
C. Annual Performance Evaluation for SO2
D. Data Representativeness
E. Data Comparability
F. Data Completeness

Meteorological Sensor Data Validation Table

Critical Validation Criteria

Criteria	*Description*	*Frequency*	*40 CFR Reference EPA QA Guidance*
Standard Reporting Units			
Wind speed	m/s	All data	EPA-454/R-99-005
Wind direction	0-360 degrees		
Temperature	Celsius		
Barometric Pressure	mbar		
Relative Humidity	Percent		
Equipment			
Wind speed sensor	Meets recommended specs in guidance	Purchase	EPA-454/R-99-005
Wind direction sensor			
Temperature sensor			
Barometric pressure sensor			
Relative humidity sensor			
Completeness			
Annual – all parameters	90% hourly data capture/calendar qtr	1 year (all calendar qtrs)	EPA-450/4-87-007
Hourly avg.-all parameters	>45 min/hourly average	hourly average	
Calibration			
All sensors calibrated by manufacturer	According to manufacturer specs and within EPA accuracy criteria	Semi-annually	EPA-454/R-99-005
Performance Audit			
Audit and Calibration Standards	Audit Std independent from Cal Stds	Within std certification freq	EPA-454/R-99-005
Wind speed	Co-located transfer standard	Semi-annually	
WS bearing torque meter	Sensor control method		
Wind direction	Sensor control method		
WD bearing torque meter	Sensor control method		
Temperature	Co-located transfer standard		
Delta temperature	Co-located transfer standard		
Barometric pressure	Co-located transfer standard		
Relative Humidity	Co-located transfer standard		
Solar radiation	Co-located transfer standard		
Precipitation	Burette		
Assessments			
Accuracy Performance Evaluation	All sensors	Semi-annually and within 30 days of site start-up	EPA-454/R-99-005

Meteorological Sensor Data Validation Table

QA/QC Operational Evaluations

Criteria	*Description*	*Frequency*	*40 CFR Reference EPA QA Guidance*
Range Checks & Data Screening Criteria (EPA Suggested to Flag Data If:)			
Wind direction	Is <0 or >360 degrees	All data	EPA-454/R-99-005, Section 8.6, Table 8-4
	WD does not vary ≥1°/3 consecutive hrs.		
	WD does not vary ≥10°/18 consecutive hrs.		
Wind speed	Is <0 or >25 m/s		
	Doesn't vary >0.1m/s - 3 consecutive hrs.		
	Doesn't vary >0.5m/s - 12 consecutive hrs.		
Temperature	T <local record low, or >local record high		
	>5°C change from previous hour		
	Doesn't vary > 0.5°C for 12 consecutive hrs		
Barometric pressure	pressure >1060 mbar (sea level)		
	pressure <940 mbar (sea level)		
	pressure varies >6mb/3hours		
Relative Humidity (Dew Point)	Dew Point ≤ Amb. Temp. for time period		
	Δ Dew Point Temp. ≤5°C from previous hour		
	Δ Dew Point Temp. ≤0.5°C over 12 hours		
	Dew Point Temp. ≠ Amb. Temp. for 12 hours		
Calibrations			
All sensors calibrated by manufacturer	According to manufacturer specs	Every six months	EPA-454/R-99-005
WD alignment	WD alignment to true N verified by TSN		
Quality Control (QC) Checks - Visual inspections			
Wind speed sensor	Moving freely, no visual damage	Each site visit	EPA-454/R-99-005
Wind direction sensor	Moving freely, no visual damage		
Temperature sensor	No visual damage or obstruction		
Barometric pressure sensor	No visual damage or obstruction		
Relative humidity sensor	No visual damage or obstruction		
Time and Date DAS	DAS time/date agree with NIST time		
Assessments - Systems Audit			
Thorough review of entire monitoring system including field systems, data management, and data reporting.	In compliance with approved QAPP	1/year and <30 days of site start-up	EPA-454/R-99-005

Meteorological Sensor Data Validation Table			
QA/QC Operational Evaluations			
Criteria	***Description***	***Frequency***	***40 CFR Reference EPA QA Guidance***
Audit Performance Evaluation			
Wind speed	±0.2 m/s ±5%	Semi-annually and ≤30 days of site start-up	EPA-454/R-99-005
WS bearing torque threshold	≤1.0 gm-cm		
Wind direction	±5 degrees		
WD linearity crossover	±3° (included in ±5° above)		
WD bearing torque threshold	≤11.0 gm-cm		
Temperature	±0.5° Celsius		
Relative Humidity-Dew Pt Temp	±7%, ±1.5° Celsius		
Barometric pressure	±3 mbar		
Systematic Issues			
Standard Reporting Units			
Wind speed	0 – 50 m/s	All data	EPA-454/R-99-005
Wind direction	0-360 degrees		
Temperature	-50 to +50 Celsius		
Relative Humidity-Dew Pt Temp	0 – 100% Humidity		
Barometric pressure	800 – 1100 mbar		
Assessments -Systems Audit			
Thorough review of entire monitoring system (field, lab, data, etc.)	In compliance with approved QAPP	Once per year and ≤30 days within site start-up	EPA-454/R-99-005

SO2 DATA VALIDATION TABLE			
Requirement	**Frequency**	**Acceptance Criteria**	**Information /Action**
CRITICAL CRITERIA			
One Point QC Check Single analyzer	1/ 2 weeks	≤ ±10% (percent difference)	0.01 - 0.10 ppm Relative to routine concentrations 40 CFR Part 58 App A Sec 3.2
Zero/span check	1/ 2 weeks	Zero drift ≤ ± 3 PPB over 24 hours Biweekly drift of ≤ ± 5 PPB Span drift ≤ ± 10 %	Zero drift acceptance criteria as revised in the June 3, 2014 EPA Memorandum
OPERATIONAL CRITERIA			
Shelter Temperature			
Temperature range	**Daily** (hourly values)	20 to 30° C. (Hourly avg.) or per manufacturers specifications if designated to a wider temperature range	Generally the 20°-30° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance
Temperature Control	Daily (hourly values)	≤ ± 2° C SD over 24 hours	
Temperature Device Check	2/year	± 2° C of standard	
Precision (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	90% CL CV ≤ 10%	90% Confidence Limit of coefficient of variation 40 CFR Part 58 App A sec 4.1.2
Bias (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	95% CL ≤ ± 10%	95% Confidence Limit of absolute bias estimate 40 CFR Part 58 App A sec 4.1.3
Annual Performance Evaluation			
Single analyzer	Every site 1/year 25 % of sites quarterly	Percent difference of audit levels 3-10 ≤ ±15% Audit levels 1&2 ± 1.5 ppb difference or ±15%	3 consecutive audit concentrations not including zero 40 CFR Part 58 App A sec 3.2.2
Primary QA Organization (PQAO)	annually	95% of audit percent differences fall within the one point QC check 95% probability intervals at PQAO level of aggregation	40 CFR Part 58 App A sec 4.1.4
Federal Audits (NPAP)	1/year at selected sites	Mean absolute	40 CFR Part 58 App A

SO2 DATA VALIDATION TABLE			
Requirement	**Frequency**	**Acceptance Criteria**	**Information /Action**
	20% of sites audited	difference ± 15%	sec 2.4
State audits	1/year	State requirements	
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving 1/6 months if manual zero/span performed biweekly 1/year if continuous zero/span performed daily	All points within ± 2 % of full scale of best-fit straight line	Multi-point calibration (0 and 4 upscale points)
Zero Air		Concentrations below LDL	
Gaseous Standards		NIST Traceable (e.g., EPA Protocol Gas)	Vendor must participate in EPA Protocol Gas Verification Program 40 CFR Part 58 App A sec 2.6.1
Zero Air/ Zero Air Check	1/year	Concentrations below LDL	
Gas Dilution Systems	1/6 months	Accuracy ± 2 %	
Detection			
Noise	NA	0.001 ppm	40 CFR Part 53.20
Lower detectable level	1/year	0.002 ppm	40 CFR Part 53.20
SYSTEMATIC CRITERIA			
Standard Reporting Units	All data	ppb (final units in AQS)	
Completeness	1 hour standard	Hour – 75% of hour Day- 75% hourly Conc Quarter- 75% complete days Years- 4 complete quarters 5-min value reported only for valid hours	40 CFR Part 50 App T Section 3 (b), (c). 5-min values or 5-min max value only reported for the valid portion of the hour reported. If the hour is incomplete no 5-min or 5-min max reported.
Sample Residence Times		< 20 seconds	
Sample Probe, Inlet, Sampling Train		Borosilicate glass (e.g., Pyrex®) or Teflon®	40 CFR Part 58 App E
Siting		Un-obstructed probe inlet	40 CFR Part 58 App E

Continuous Gas Analyzer Audit Concentration Ranges	
Audit Point	**SO_2 Concentration Range (ppm)**
0	0.000
1	0.0500 – 0.0999
2	0.1500 – 0.2599
3	0.2600 – 0.7999

Appendix 5

US EPA National Ambient Air Quality Standards (NAAQS)

National Ambient Air Quality Standards (NAAQS)			
Pollutant	**Standard Type**	**Averaging Time**	**Concentration**
SO2	Primary	1-Hour	75 ppb [1]
	Secondary	3-Hour	0.5 ppm [2] (500 ppb)

Notes

[1] 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years

[2] Not to be exceeded more than once per year

APPENDIX 6

LIST OF ACRONYMS

APCP - Air Pollution Control Program

AQAU - Air Quality Assurance Unit

AQMS - Air Quality Monitoring Section

AQS – Air Quality System

CFR – Code of Federal Regualtions

CTS – Collocated Transfer Standard

DAS – Data Acquisition System

DQO - Data Quality Objective

EPA - United States Environmental Protection Agency

ESP - Environmental Services Program

EPA – United States Environmental Protection Agency

FEM - Federal Equivalent Method

FRM - Federal Reference Method

LDL – Lower Detectable Limit

MDNR – Missouri Department of Natural Resources

MDQO – Measurement Data Quality Objectives

NAAQS - National Ambient Air Quality Standards

NIST – National Institute of Standards and Technology

NWS – National Weather Service

PARS - Precision Accuracy Reporting System

PM – Particulate Matter

PPM - Parts Per Million

QA/QC - Quality Assurance/Quality Control

QAPP - Quality Assurance Project Plan

RO - Reporting Organization

SIP - State Implementation Plan

SLAMS - State/Local Air Monitoring Station

SO2 – Sulfur Dioxide

SOP - Standard Operating Procedure

SPMS - Special Purpose Monitoring Stations

TBD – To Be Determined

TSA – Technical Systems Audit

APPENDIX 7

REFERENCES

U. S. Code of Federal Regulations, Title 40, Part 50

U. S. Code of Federal Regulations, Title 40, Part 53

U. S. Code of Federal Regulations, Title 40, Part 58

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, U. S. EPA, 2013, EPA-454/b-13-003

Ambient Monitoring Guidelines for the Prevention of Significant Deterioration (PSD) (EPA 450/4-87-007, May 1987*)*

*EPA Requirements for Quality Assurance Project Plans (QA/R-5), (*EPA/240/B-01/003, March 2001);

*Guidance for Preparing Standard Operating Procedures (SOPs) (*EPA QA/G-6; (EPA/240/B-01/004, March 2001)*;*

Guideline on Air Quality Models, U. S. Code of Federal Regulations, Title 40, Part 51, Appendix W.

Meteorological Monitoring Guidance for Regulatory Modeling Applications, U. S. EPA, 2000, EPA-454/R-99-005

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, U. S. EPA, 2008, EPA-454/B-08-002

Ambient Air Monitoring QAPP Template, Revised 2014, Missouri Department of Natural Resources;

Instructions on completing the MDNR/Ambient Air Monitoring QAPP Template, Missouri Department of Natural Resources.

APPENDIX 8

REPORTS, RECORDS & FORMS USED IN THE MONITORING PROGRAM

Field notebooks to be maintained-Include hardbound notebooks or e-records documenting activities related to the project.
Field examples include:

1. Site visit entries by any personnel
2. Preventative and corrective site maintenance
3. Instrument maintenance
4. Power failures and instrument changes

Quality control records-These include:

1. Span and zero checks
2. Flow checks
3. Calibration records
4. Certifications and traceability of standards

Raw data-This can include raw electronic data, filter media and trace recorder charts.

Data Reports-Will include:

1. Any data algorithms used to process the raw dataset.
2. Agency internal data management plans with flow charts.
3. The results of the verification process
4. The results of the validation process
5. The results of the data quality assessment which will state whether or not data provided meets the quality, quantity and type required.
6. Precision and Bias results and the equations used to calculate.
7. Completeness percentages.
8. List of any missing, invalidated or manipulated data with detailed information about each occurrence.
9. Validated dataset in both paper copy and electronic form. The electronic version to be in AQS format.

Performance audit reports-Summarize and include audits both external and internal (NPAP if applicable).

System audits- Summarize and include any system audits.

FORM 7-1: SO_2 SYSTEM ROUTINE CHECK FORM

Network: _____ Site Name: _____

Dates of Checks:➔				
Operator's Initials:➔				

GENERAL SITE CONDITIONS

Shelter Min/Max Temp. (Must be within 20º-30º C)	Min	Max	Min	Max	Min	Max	Min	Max
Shelter and Site Conditions OK? (Y or N; Explain in "Comments" if N)								
Sample intake and lines clean, intact and free of moisture? (Y or N)								

SO_2 ANALYZER CHECKS

Analyzer Mfg./Model#: _____ S/N: _____ Last Cal. Date: _____

Analyzer in normal SAMPLE mode?: (Y or N)				
Analyzer CONC value (PPB): (current instantaneous concentration)				
Analyzer TIME OF DAY correct: (Y or N, ± 1 minute true)				
Analyzer RANGE set to 500 PPB and SINGLE range? (Y or N):				
Analyzer STABIL value (PPB): (≤ 1 ppb / Zero Air)				
Analyzer SAMP PRESS (in-Hg-A): (Ambient ±2 in-Hg-A)				
Analyzer SAMPLE FLOW (cm^3/min): (650 cm^3/min ± 10%)				
Analyzer PMT SIGNAL (mV):				
Analyzer NORM PMT SIGNAL (mV):				
Analyzer UV LAMP (mV): (1000 to 4800 mV)				
Analyzer LAMP RATIO (%): (30 to 120 %)				
Analyzer STR LIGHT (PPB): (≤ 100 ppb / Zero Air)				
Analyzer DARK PMT (mV): (-50 to 200 mV)				
Analyzer DARK LAMP (mV): (-50 to 200 mV)				
Analyzer SLOPE: (1.0 ±0.3)				
Analyzer OFFSET (mV): (<250 mV)				
Analyzer HVPS (V): (~400 to 900 V)				
Analyzer RCELL TEMP (º C): (50º C ± 1º C)				
Analyzer BOX TEMP (º C): (ambient temp + ~ 5º C)				
Analyzer PMT TEMP (º C): (7º C ± 2º C constant)				
Most recent SO_2 AutoCal (Level 2) SPAN (PPB): (400 PPB ±40 PPB)				
Most recent SO_2 AutoCal (Level 2) ZERO (PPB): (<10 PPB)				
Any analyzer ERROR MSGS? (Y or N):				
Change sample particulate filter? (Y or N)				

Comments: _____

Technician: _____

QA Review: _____

ENVIROPLAN CONSULTING

SO2 ANALYZER CALIBRATION FORM

Calibration Data on This Form Are For:_____ P/Z/S Check_____ Unadjusted Cal._____ Adjusted Cal.

Network:	Site:	Date:
Time Off-Line:	Time On-Line:	Technician:

Calibration Equipment Info.	Analyzer Mfg./Model No.: TAPI T100	S/N:	Last Cal'd:
	Calibrator Mfg./Model No.: TAPI T700	S/N:	Cal. Date:
	Gas Cylinder Supplier: Scott Marrin Gas	Cyl. Cert. Date:	Cyl. Pressure: PSIG
	Gas Cylinder ID #:	SO2 Cyl Conc.: ppm	Site Temp.: °C

Analyzer Calibration Settings	**"As Found" (Before Any Adjustment)**	**"As Left" (After Adjustment)**
SLOPE		
OFFSET		

INPUT GAS DATA					**OBSERVED RESPONSES**	
Gas Ch. Display Setting	Gas Ch. Flow Rate (LPM)	Air Ch. Display setting	Air Ch. Flow Rate (LPM)	SO2 Gas Input Conc. (PPB)	SO2 Channel Response (PPB)	Δ%
OFF	OFF			0		

LINEAR REGRESSION ANALYSIS RESULTS

Slope=	Intercept=	Corr. (r)=

NOTES:

1. A valid "As Found" P/Z/S check must be performed prior to performing an adjusted-response calibration IF the analyzer is operational and producing data.

2. If the results of the "As Found" P/Z/S check cited above exceed ±5 ppb for zero and/or ±10% deviation for either span or precision response, the technician should perform an "As Left" (Adjusted Response) calibration.

3. Any "As Left" (Adjusted Response) Calibration results should be ≤ ±3 ppb for zero and ≤ ±5% of True for any non-zero point.

Comments: _____

_____

Technician: _____

QA Review: _____

AIR QUALITY SYSTEMS AUDIT CHECKLIST
(Page 1 of 2)

Network:	Audit Date:
Site:	Auditor:

Parameter Monitored	Monitor Model	Monitor Serial No.	Range	Last Calibration

OPERATIONS (CONTINUOUS ANALYZERS)	YES	NO
Are all monitors operational?		
Are all analyzer and calibrator fans operational and clean?		
Are all flow rates for analyzers normal?		
Is automatic zero/span operational?		
Is calibration of all monitors current?		
Are analyzer particulate filters changed bi-weekly?		
Is sampling cane and manifold clean and intact?		
Is the manifold blower motor working?		
Are all sample lines clean and moisture free?		
Is DAS operational and indicating proper time and date?		
Are site visits performed at weekly intervals?		
Are zero/span/precision checks performed weekly?		
Are multi-point calibrations performed semi-annually and on time?		
GENERAL SITE CONDITIONS	**YES**	**NO**
Is the station interior neat and orderly?		
Is the condition of trailer exterior acceptable?		
Is the site temperature maintained between 20° and 30°C?		
Are the site grounds well maintained?		
DOCUMENTATION AND FORMS	**YES**	**NO**
Is the station logbook present?		
Are the station logs up-to-date?		
Are the station logs detailed and legible?		
Are the calibration forms present?		
Are calibration certificates for gas cylinders and calibrators posted?		

AIR QUALITY SYSTEMS AUDIT CHECKLIST
(Page 2 of 2)

Network:	Audit Date:
Site:	Auditor:

OVERALL COMMENTS	YES	NO
Overall, is the station well maintained?		
Overall, is the data quality good?		
Are Quality Assurance/Quality Control maintained?		
Is the site and equipment in good working order?		
Overall, is the site technician knowledgeable and following Standard Operating Procedures?		
Are there any unresolved problems at the site? (describe in "Comments" below)		

Comments:

Site Technician:_____

Auditor:_____

QA Review:_____

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CONTINUOUS GASEOUS POLLUTANT ANALYZER AUDIT FORM

PARAMETER AUDITED (Check One): ___SO_2 ____CO _____TRS

Network:		**Site:**	**Audit Date:**
Time Off-Line:		**Time On-Line:**	**Shelter Temperature:**
Site Equipment	Analyzer Mfg./Model No.:	S/N:	Cal. Date:
	Analyzer Calibration Settings: Span Setting:	Zero Setting:	
	Calibrator Mfg./Model No.:	S/N:	Cal. Date:
	Gas Cylinder Vendor and S/N:		Tank Pressure: PSIG
	Gas Cylinder Cert. Date:		Cylinder Conc. (ppm):
Audit System	Calibrator Mfg./ Model No.:	S/N:	Cal. Date:
	Zero Air Supply Mfg./Model No.:	S/N:	
	Gas Cylinder Vendor and S/N:		Tank Pressure: PSIG
	Gas Cylinder Cert. Date:		Audit Cylinder Conc. (ppm):

Calibrator Gas Flow		Calibrator Dilution Flow		Known Audit Concentration Units: ___ppb __ppm	System Response		Results
Calibrator Setting	SCCM	Calibrator Setting	SCCM		Analyzer Output (Volts)	DAS Units:__ppb ___ppm	Δ%
OFF	OFF						
Slope =		Intercept =			Correlation Coefficient (r) =		

Auditor: _____

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FORM 10-1: METEOROLOGICAL SYSTEMS AUDIT CHECKLIST (Page 1 of 2)

Network:	Audit Date:
Site:	Auditor:

GENERAL SITE CONDITIONS	Yes	No
Is the station interior neat and orderly?		
Is the structural condition of the equipment shelter acceptable?		
Is the shelter temperature regulation compatible with stable and proper instrument operation?		
Are the site grounds well maintained?		

EXPOSURE OF INSTRUMENTS	Yes	No
Are all booms rigid, level and properly aligned?		
Are wind sensors plumb, and rigidly mounted at least two tower widths away from tower?		
Is the tower in good physical condition, rigid and all tower cables secure?		
Are temperature sensors housed in aspirated radiation shields?		
Are humidity and/or dew point sensors housed in aspirated radiation shields?		
Are radiation sensors clean, level and unobstructed from the sun all year?		
Are precipitation sensors properly elevated, level, located away from any drip lines and protected with a wind break?		

OPERATIONS	Yes	No
Are all sensors operational?		
Are all signal connections clean, protected and rust free?		
Are all vanes/cups/propellers intact?		
Are wind speed and wind direction bearings replaced on schedule?		
Are all wind sensor heating jackets intact and operational?		
Are all aspirators clean and aspirator fan(s) operational?		
Is the precipitation gauge clean?		
Is D.A.S. operational and indicate proper time and date?		
Are routine site checks performed at weekly intervals?		
Are calibration checks performed as scheduled?		

FORM 10-1: METEOROLOGICAL SYSTEMS AUDIT CHECKLIST (Page 2 of 2)

Network:	Site:	Audit Date:

DOCUMENTATION AND FORMS	Yes	No
Are QA/QC objectives and procedures documented?		
Is the station logbook present?		
Are the station logs up-to-date?		
Are the station logs detailed and legible?		
Are the system calibration forms present?		

OVERALL COMMENTS	Yes	No
Overall, are the station and instruments well maintained?		
Is the site and equipment in good working order?		
Overall, is the site technician knowledgeable and following SOPs?		
Overall, are monitoring activities consistent with data quality objectives?		
Does system data agree with the current ambient conditions?		
Does the station siting conform to applicable guidelines?		

Comments:

Site Technician:_____ Auditor:_____

QA Review:_____

FORM 10-2: PERFORMANCE TEST DATA FOR HORIZONTAL WIND SPEED MEASUREMENT SYSTEM

Performance Test is a: _____Audit (or) _____Calibration (check one; if calibration, explain reason below)

Network:	Test Date(s):
Site:	Site Operator:
Sensor Level (AGL):	Instrument Range: 0.0 mph to 100.0 mph
Location:	Time off line: Time on line:

System Component	Manufacturer	Model Number	Serial Number "As Found"	Serial Number "As Left"
Sensor	Climatronics	100075		
Data Acquisition System	Campbell Scientific	CR-1000		

WS PERFORMANCE TEST ACCEPTABILITY LIMITS (Climatronics F-460 Cup Anemometer)		
Type of Test	**"As Found"**	**"As Left"**
1. Sensor Starting Torque	< 0.2 gm-cm	Same as "As Found"
2. Overall System Error	≤ 0.6 mph (compared to True)	Same as "As Found"

SYSTEM TEST RESULTS:

STATUS	MOTOR RPM	TARGET (mph) (**A**)	DAS (mph) (**B**)	ERROR (mph) (= **B-A**)
AS FOUND	0	0.3		
	300	16.1		
	600	31.8		
	900	47.6		
AS LEFT	0	0.3		
	300	16.1		
	600	31.8		
	900	47.6		

"As Found" bearing torque check: Clockwise_____gm-cm; Counter-clockwise_____gm-cm

Sensor bearings: Last replaced: _____ Next due:_____

"As Left" bearing torque check: Clockwise_____gm-cm; Counter-clockwise_____gm-cm

Comments: _____

_____

_____

Technician: _____ Auditor: (if applicable)_____

QA Review: _____ ***ENVIROPLAN CONSULTING***

FORM 10-3: PERFORMANCE TEST DATA FOR VERTICAL WIND SPEED MEASUREMENT SYSTEMS

Performance Test is a: _____Audit (or) _____Calibration (check one; if calibration, explain reason below)

Network	Test Date(s):
Site:	Site Operator:
Sensor Level (AGL):	Instrument Range: -25.0 mph to 25.0 mph
Location:	Time off line: Time on line:

System Component	Manufacturer	Model Number	Serial Number "As Found"	Serial Number "As Left"
Sensor	Climatronics	102236		
Data Acquisition System	Campbell Scientific	CR-1000		

WS PERFORMANCE TEST ACCEPTABILITY LIMITS
(Climatronics Vertical Component Anemometer)

Type of Test	"As Found"	"As Left"
1. Sensor Starting Torque	< 0.3 gm-cm	< 0.14 gm-cm
2. Overall System Error	≤ 0.6 mph (compared to True)	Same as "As Found"

SYSTEM TEST RESULTS:

STATUS	MOTOR RPM	TARGET (mph) (**A**)	"AS FOUND"		"AS LEFT"	
			DAS (mph) (**B**)	ERROR (mph) (= **B-A**)	DAS (mph) (**C**)	ERROR (mph) (= **C-A**)
CLOCKWISE	0	0.0				
	300	4.2				
	600	8.4				
	900	12.6				
COUNTER-CLOCKWISE	0	0.0				
	300	-4.2				
	600	-8.4				
	900	-12.6				

"As Found" bearing torque check: Clockwise_____gm-cm; Counter-clockwise_____gm-cm

Sensor bearings: Last replaced:_____ Next due:_____

"As Left" bearing torque check: Clockwise_____gm-cm; Counter-clockwise_____gm-cm

Comments: _____

_____

_____

Technician: _____ Auditor: (if applicable)_____

QA Review: _____ ***ENVIROPLAN CONSULTING***

FORM 10-4: PERFORMANCE TEST DATA FOR WIND DIRECTION MEASUREMENT SYSTEMS

Performance Test is a: _____Audit (or) _____Calibration (check one; if calibration, explain reason below)

Network:	Test Date(s):
Site:	Site Operator:
Sensor Level (AGL):	Instrument Range: 0 to 360 Degrees
Location:	Time off line: Time on line:

System Component	Manufacturer	Model Number	Serial Number "As Found"	Serial Number "As Left"
Sensor	Climatronics	100076		
Data Acquisition System	Campbell Scientific	CR-1000		

WD PERFORMANCE TEST ACCEPTABILITY LIMITS		
Type of Test	**"As Found"**	**"As Left"**
1. Sensor Starting Torque	< 6 gm-cm (CW & CCW)	< 3 gm-cm (CW & CCW)
2. Sensor Orientation Error	± ≤ 2^o	± ≤ 1^o
3. Total System Azimuth Error	± ≤ 5^o	± ≤ 5^o (preferably ± ≤ 3^o)

SYSTEM TEST RESULTS:

	AS FOUND			AS LEFT		
TEST POINT (**A**)	DAS (**B**)	Sensor Error (B-A) = **C**	Total Error (= C-D)	(**E**) DAS	Sensor Error (A-E) = **F**	Total Error (= F-G)
30°						
60°						
90°						
120°						
150°						
180°						
210°						
240°						
270°						
300°						
330°						
360°						

Sensor orientation relative to true north: **(D)**_____Degrees (as found); **(G)**_____Degrees (as left)

"As found" bearing torque check: Clockwise_____gm-cm; Counter-clockwise_____gm-cm

Bearings last replaced:_____ Next Due: _____

"As left" bearing torque check: Clockwise_____gm-cm; Counter-clockwise_____gm-cm

Comments: Magnetic Declination of Site =
Technician:_____ Auditor: (if applicable):_____

QA Review: _____

FORM 10-5: PERFORMANCE TEST DATA FOR AMBIENT TEMPERATURE MEASUREMENT SYSTEMS

Performance Test is a: _____Audit (or) _____Calibration (check one; if calibration, explain reason below)

Network:	Test Date(s):
Site:	Site Operator:
Sensor Level (AGL):	Instrument Range: -30.0 to +50.0 °C
Location:	Time off line: Time on line:

System Component	Manufacturer	Model Number	Serial Number "As Found"	Serial Number "As Left"
Sensor	Climatronics	100093		
Data Acquisition System	Campbell Scientific	CR-1000		

TEMPERATURE PERFORMANCE TEST ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
1. Total System Error (DAS Response - Reference Temp. = Error)	Error ≤ ± 0.5° C (each test point)	Error ≤ ± 0.5° C (each test point) **(Preferably: ≤ ± 0.2° C, each test point)**

SPECIAL NOTES:

1. Assess system accuracy at three known temperatures (immersing the probe and reference thermometer together in stable thermal masses). Known temperatures should include an ice slurry bath, a "room temp." bath (~ 15° ~ 27° C) and a "hot" bath (75 ~ 95% of positive portion of measurement range).

2. Ensure probe radiation shield is clean, in good physical condition and has unobstructed air flow. If shield is actively aspirated, ensure blower fan is operating properly. Note any deficiencies in "Comments" section below.

System Test Results:

TEST POINT	"AS FOUND"				"AS LEFT"			
	Reference Temp. (°C) (**A**)	DAS (°F)	DAS (°C) (**B**)	System Error (°C) (**= B – A**)	Reference Temp. (°C) (**A**)	DAS (°F)	DAS (°C) (**B**)	System Error (°C) (**= B – A**)
Ice Bath (0.1 – 0.2°C)								
"Ambient" (15 – 25°C)								
Hot Bath (35 – 48°C)								

Comments: _____

_____

_____

Technician: _____ Auditor: (if applicable): _____

QA Review: _____ *ENVIROPLAN CONSULTING*

FORM 10-6: PERFORMANCE TEST DATA FOR DELTA TEMPERATURE MEASUREMENT SYSTEMS

Performance Test is a: _____Audit (or) _____Calibration (check one; if calibration, explain reason below)

Network:	Test Date(s):
Site:	Site Operator:
Sensor Level (AGL):	Instrument Range: -5.0 to +10.0 ^{o}C
Location:	Time off line: Time on line:

System Component	Manufacturer	Model Number	Serial Number "As Found"	Serial Number "As Left"
Sensor	Climatronics	100093		
Data Acquisition System	Campbell Scientific	CR-1000		

DELTA-TEMPERATURE PERFORMANCE TEST ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
1. Total System Error (DAS Response - Designated Response Temp. = Error)	Error ≤ ± 0.1^{o} C	Error ≤ ±0.1^{o} C

SPECIAL NOTES: Assess system accuracy at five known temperatures as follows:

1. Immerse ambient and delta-temp probes together in three different stable thermal baths consisting of: an ice slurry bath, an "Ambient" bath (~15°-25°C) and a "hot" bath (35 – 48^{o}C).
2. Immerse ambient and delta-temp probes separately in 2 stable thermal baths to generate known delta temps in the following ranges: -4.9 to -3^{0}C and +7.5 to 9.9^{o}C.

SYSTEM PERFORMANCE TEST RESULTS

"AS FOUND" (All Values in °C)					"AS LEFT" (All Values in °C)				
Ambient Reference Temp. (**A**)	Δ- T Reference Temp. (**B**)	Target Δ-T Response (**B-A) = C**	DAS Δ-T (**D**)	Δ-T Error (= **D - C**)	Ambient Reference Temp. (**A**)	Δ- T Reference Temp. (**B**)	Target Δ-T Response (**B-A) = C**	DAS Δ-T (**D**)	Δ-T Error (= **D - C**)

Comments: _____

Technician: _____ Auditor: (if applicable): _____

QA Review: _____

FORM 10-7: PERFORMANCE TEST DATA FOR TIPPING BUCKET-TYPE PRECIPITATION SYSTEMS

Performance Test is a: _____Audit (or) _____Calibration (check one; if calibration, explain reason below)

Network	Test Date(s):
Site:	Site Operator:
Sensor Level (AGL):	Sensor Transfer Function: 8.24ml = 1 tip = 0.01" of precipitation (for 8-inch diameter bucket)
Location:	Time off line: Time on line:

System Component	Manufacturer	Model Number	Serial Number
Sensor	Climatronics	100097	
Data Acquisition System	Campbell Scientific	CR-1000	

PRECIPITATION PERFORMANCE TEST ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
1. Total System Error (the percent difference of the DAS-indicated and the actual equivalent).	Error ≤ ± 10%	Error ≤ ± 10%

SYSTEM PERFORMANCE TEST:

A) 1.) Total volume of water introduced (from burette) _____ ml

2.) Rainfall equivalent of (A-1)_____ (use mfg's. transfer function for sensor)

B) 1.) Total number of bucket tips during test _____

2.) Rainfall equivalent of (B-1)_____ (use mfg's. transfer function for sensor)

C) DAS rainfall indication before test _____ (eng. units); after test _____ (eng. units)

D) Total rainfall indicated by DAS _____ (Hourly data value, eng units)

E) Percent difference: $\frac{D - A2}{A2} \times 100 =$ _____%

Comments: _____

_____

_____

_____

Technician: _____ Auditor: (if applicable): _____

QA Review: _____ ***ENVIROPLAN CONSULTING***

FORM 10-8: PERFORMANCE DATA FORM FOR SOLAR RADIATION MEASUREMENT SYSTEMS

Performance Test is a: _____Audit (or) _____Calibration (check one; if calibration, explain reason below)

Network:	Test Date(s):
Site:	Site Operator:
Sensor Level (AGL):	Instrument Range: 0.0 to 1,395 W/m^2
Location:	Time off line: Time on line:

Site System Component	Manufacturer	Model Number	Serial Number "As Found"	Serial Number "As Left"
Sensor	Eppley	8-48		
Data Acquisition System	Campbell Scientific	CR-1000		

Audit/CTS Equipment:

Component	Manufacturer	Model Number	Serial Number
Sensor	Eppley	8-48	17204
Data Acquisition System	Campbell Scientific	CR-1000	

SOLAR RADIATION PERFORMANCE TEST ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
1. Total System **(Averaged)** Error (the arithmetic averaged error obtained from a full diurnal cycle (preferred) or several hours prior to and after peak solar radiation).	Average Error ≤ ± 5%	Average Error ≤ ± 5%

Summarized System Performance Test Results:

START Date & Time	END Date & Time	Audit CTS Average W/m^2 (A) *	Site System Average W/m^2 (B) *	Discrepancy (B-A) ÷ A * 100
				%

*** NOTE:** Hours during which either measurement system reports values that are <5% of full scale range (i.e., <70W/m^2) are **excluded** from the total average)

Comments: _____

_____

_____

Technician: _____ Auditor: (if applicable): _____

QA Review: _____ ***ENVIROPLAN CONSULTING***

FORM 10-9: PERFORMANCE TEST DATA FOR RELATIVE HUMIDITY (RH) MEASUREMENT SYSTEMS

Performance Test is a: _____Audit (or) _____Calibration (check one; if calibration, explain reason below)

Network:	Test Date(s):
Site:	Site Operator:
Sensor Level (AGL):	Instrument Range: 0 to 100%
Location:	Time off line: Time on line:

Site System Component	Manufacturer	Model Number	Serial Number
Sensor	Climatronics	102798	
Data Acquisition System	Campbell Scientific	CR-1000	

RELATIVE HUMIDITY PERFORMANCE TEST ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
1. Total System **(Averaged)** Error (the arithmetic averaged error obtained from three or more discrete comparison checks).	Average Error ≤ ± 7%	Average Error ≤ ± 7%

SYSTEM PERFORMANCE TEST RESULTS

Test Time (L.S.T.)	REFERENCE PSYCHROMETER			SYSTEM READING	ERROR (%)
	Dry Bulb (°C)	Wet Bulb (°C)	Reference RH (%) (**A**)	DAS RH (%) (**B**)	**= B - A**
Average System Error = %					

Comments: _____

_____

_____

_____

Technician: _____ Auditor: (if applicable): _____

QA Review: _____ ***ENVIROPLAN CONSULTING***

FORM 10-10: PERFORMANCE TEST DATA FOR BAROMETRIC PRESSURE MEASUREMENT SYSTEM

Performance Test is a: _____Audit (or) _____Calibration (check one; if calibration, explain reason below)

Network:	Test Date(s):
Site:	Site Operator:
Sensor Level (AGL):	Instrument Range: 800 – 1100 mb
Location:	Time off line: Time on line:

Site System Component	Manufacturer	Model Number	Serial Number
Sensor	Climatronics	102663	
Data Acquisition System	Campbell Scientific	CR-1000	

Audit/CTS Equipment:

Component	Manufacturer	Model Number	Serial Number
Sensor	Setra	370	4493426

BAROMETRIC PRESSURE PERFORMANCE TEST ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
1. Total System **(Averaged)** Error (the arithmetic averaged error obtained from three or more discrete comparison checks).	Average Error ≤ ± 3mb	Average Error ≤ ± 3mb

SYSTEM PERFORMANCE TEST RESULTS

Test Time (L.S.T.)	REFERENCE BAROMETER	SYSTEM READINGS	ERROR (mb)
	Reference Barometric Pressure (mb)	DAS (mb)	
Average System Response Error =			mb

Comments: _____

_____

_____

Technician: _____ Auditor: (if applicable): _____

QA Review: _____

FORM 10-11: AUDIT EQUIPMENT SUMMARY SHEET

Network:	Audit Date:
Site:	Auditor:

Audit Equipment	Manufacturer	Model	Serial Number	Cal. Date	Due Date
Digital Multimeter					
Wind Speed Motor					
Wind Direction Azimuth Test Fixture					
Crossarm Alignment Check Instrument(s)					
Torque Watch					
Psychrometer					
Air Thermometers					
Immersion Thermometer					
Immersion Thermometer					
Immersion Thermometer					
Burette					
Pressure Standard					
Radiation Standard					

APPENDIX 9

STANARD OPERATING PROCEDURES

FOR MAJOR MONITORING EQUIPMENT